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(71)Applicant : SHARP CORP

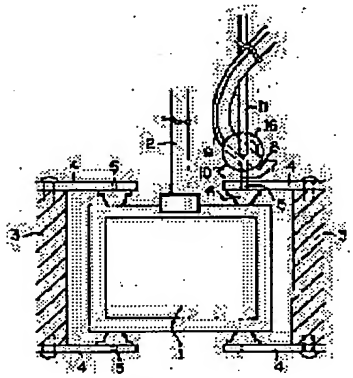
(72)Inventor : SATO YASUTO

(54) METHOD AND APPARATUS FOR FIXING LIQUID CRYSTAL PANEL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method and an apparatus for fixing a liquid crystal panel, whereby the high-precision panel positioning can be performed by an automated process.

SOLUTION: In the production of a liquid crystal image projector provided with a plurality of liquid crystal panels, a liquid crystal panel 1 is positioned on the fixing member 4 of an optical unit 3 by means of a robot arm 2, and an adhesive is fed into a reservoir 6 from a nozzle tip 7 through a through-hole 5. The adhesive should have such properties that the viscosity is 12,000-20,000cP, the hardness after curing is at least 50 in terms of Shore D hardness, the curing shrinkage is 5% or below, and the coefficient of expansion is 10×10-5/degree or below. The adhesive should be a photocurable one, and the fixing member 4 should be transparent. They are irradiated with light from a light irradiation tube 8. Further, when the nozzle tip 7 and the tube 8 are disposed on a rotary drum 16, the supply of the adhesive and the light irradiation can be performed continuously. As the drum rotates, the tip 7 is received by a nozzle holder 10 so as not to cause nozzle plugging otherwise occurring upon light irradiation.



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CLAIMS

[Claim(s)]
[Claim 1] Face manufacturing liquid crystal image projection equipment equipped with a liquid crystal panel, and this liquid crystal panel is positioned in the location which can acquire the constitutionally optimal projection image of this liquid crystal image projection equipment. In the fixed approach of the liquid crystal panel which fixes this positioned liquid crystal panel to the holddown member which this liquid crystal image projection equipment has The fixed approach of a liquid crystal panel that viscosity is characterized by 12000 - 20000CPS and a hardening degree of hardness using the adhesives 5% or less and whose coefficient of thermal expansion 50 or more and hardening contraction are below the degrees of 10x10-5/in Shore-scleroscope-hardness D as a means for performing said immobilization.
[Claim 2] The fixed approach of the liquid crystal panel according to claim 1 which is made to carry out photo-curing of said adhesives, and is characterized by performing said immobilization by forming said holddown member using the ingredient of light transmission nature, and irradiating light through said holddown member at said adhesives while using photo-curing mold adhesives as said adhesives.
[Claim 3] The fixed approach of the liquid crystal panel according to claim 1 or 2 characterized by preparing the through tube which is carrying out opening to the gap prepared between said holddown members and said said positioned liquid crystal panels in said holddown member, feeding said adhesives into said gap through said through tube, and performing said immobilization.
[Claim 4] The path of said through tube is the fixed approach of the liquid crystal panel according to claim 3 characterized by being 1.5mmphi.
[Claim 5] The fixed approach of the liquid crystal panel according to claim 3 or 4 characterized by facing feeding said adhesives by fixing to said holddown member the tubed part material which has flexibility as the side edge by the side of the gap of said through tube is surrounded, and stopping the unnecessary breadth of said adhesives.
[Claim 6] In the equipment for immobilization of the liquid crystal panel which uses this liquid crystal panel positioned in the location which faces manufacturing liquid crystal image projection equipment equipped with a liquid crystal panel, and can acquire the constitutionally optimal projection image of this liquid crystal image projection equipment for the process fixed to the holddown member which this liquid crystal image projection equipment has To the right reverse which prepared in said holddown member, is a ****** through tube and was established near the side edge of the through tube which carries out opening to the gap of said liquid crystal panel and said holddown member, the body of revolution in which a roll control is possible, It comes to contain with optical exposure tubing for performing said optical exposure to the nozzle for feeding said adhesives which protruded towards the exterior of this body of revolution as made the predetermined include angle mutually, and said photo-curing mold arrival agent. Equipment for immobilization of the liquid crystal panel characterized by enabling it to perform continuously said feeding and said optical exposure of said adhesives with rotation actuation of said body of revolution.
[Claim 7] From said feeding of said adhesives, when said body of revolution rotates only said predetermined include angle on the occasion of said optical exposure shifting, actuation By preparing on said body of revolution so that it may always become an orientation, without depending on said rotation

actuation for the nozzle holder in which said nozzle which moved was held Equipment for immobilization of the liquid crystal panel according to claim 6 characterized by preventing ****** at said tip of a nozzle on the occasion of said optical exposure.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the equipment used for the mounting approach of the liquid crystal panel used for liquid crystal image projection equipment, and its equipment.
[0002]
[Description of the Prior Art] In recent years, there is a remarkable thing in the spread of liquid crystal image projection equipment. Furthermore, there is no place at which a demand to high-definition liquid crystal image projection equipment also stops. There is 3 plate type liquid crystal image projection equipment which arranged the liquid crystal panel of one sheet on the signal of RGB each color, respectively, and was used as the signal bulb as what replies to the demand. This example is explained below with reference to drawing 4 .
[0003] The light which carried out outgoing radiation from the light source 12 is once decomposed into each color of RGB by the dichroic mirror 13, and when each penetrates liquid crystal panels 1a, 1b, and 1c, the television signal of each color is written in. Each of this light is again compounded with a dichroic mirror 13 after that, and expansion projection is carried out at the screen 16 formed by separating a certain distance with the projection lens 14. Henceforth, what made one package the optic except the screen shown in drawing 4 is called an optical unit.
[0004] Under the present circumstances, in a manufacture process, the setting location in the direction of an optical axis and field inboard of a liquid crystal panel is adjusted, and the liquid crystal panels 1a, 1b, and 1c of RGB each color are fixed so that a focus, image size, and location gap may not arise on a screen. Generally the precision of micron order is required of positioning of a liquid crystal device by dozens of microns and field inboard in the direction of an optical axis, the direction of an optical axis specifically performs precision **** with the pin or rib which positions the liquid crystal of an optical unit, and field inboard attaches liquid crystal on x, y, and theta simple operation stage, and is performing optimization adjustment.
[0005]
[Problem(s) to be Solved by the Invention] However, when positioning of the liquid crystal of RGB each color is performed by such method, the following problems arise.
1. Since positioning of the direction of an optical axis of a liquid crystal panel is performed by the pin or rib prepared in the optical unit, the precision of an optical unit is required. Therefore, cost starts and also conditions, such as molding contraction of an ingredient and coefficient of thermal expansion, are

regulated.
2. The simple operation stage for positioning of the field inboard of a liquid crystal panel must be used for at least two in the liquid crystal of three sheets with which an optical unit is equipped, components mark increase, and cost increases.
3. Since still higher positioning accuracy has been required with the miniaturization of a liquid crystal panel, in the precision in said simple operation stage, positioning is becoming difficult. Moreover, the gestalt which an operator controls manually is most, and the positioning approach by this simple operation stage requires skill of an operator, and also requires time amount.
[0006] Then, the approach using the highly precise robot arm which can work to x, y, z and theta, thetah, and thetav is becoming in use to the liquid crystal panel 1 as shown in drawing 5 as an approach of automating these positioning and satisfying precision.
[0007] However, by the approach using such a robot arm, although surely positioning becomes possible easily, a trouble arises again by the approach [stationary plate / to which a liquid crystal panel is fixed] of immobilization. That is, for example, when performing immobilization of the liquid crystal panel after positioning using a pewter, a several microns error is easily produced by the heat shrink of the pewter in the case of the immobilization. Moreover, tar and the steam of a pewter adhere to a liquid crystal side, and lowering the permeability of light is also considered. a pewter is still more difficult to use it, when it comes out at most to fix a thing with spacing of 0.5mm or less and there is spacing beyond it.
[0008] Moreover, for example, when fixing the liquid crystal panel after positioning with adhesives, it becomes a technical problem how the clearance between a liquid crystal panel and a stationary plate is filled up with the adhesives of a liquid or how the effect by hardening contraction of adhesives is suppressed, and how a series of fixed processes are smoothly automated on production.
[0009] This invention was made in view of the above actual condition, and makes it the technical problem which should be solved to offer the equipment used for the fixed approach of the liquid crystal panel which enables positioning of a high precision panel according to an automation process, and implementation of the approach.
[0010]
[Means for Solving the Problem] Invention of claim 1 is faced manufacturing liquid crystal image projection equipment equipped with a liquid crystal panel. In the fixed approach of the liquid crystal panel which positions this liquid crystal panel in the location which can acquire the constitutionally optimal projection image of this liquid crystal image projection equipment, and fixes this positioned liquid crystal panel to the holddown member which this liquid crystal image projection equipment has As a means for performing said immobilization, 50 or more and hardening contraction in Shore-scleroscope-hardness D 5% or less, [viscosity] [12000 - 20000CPS and a hardening degree of hardness] And it can be characterized by using the adhesives whose coefficient of thermal expansion is below the degree of 10x10-5/, distortion resulting from the self-weight of a liquid crystal panel or hardening contraction of adhesives, deformation, generating of unnecessary stress, etc. can be suppressed, and it enables it to raise fixed precision.
[0011] In invention of claim 1, while invention of claim 2 uses photo-curing mold adhesives as said adhesives By forming said holddown member using the ingredient of light transmission nature, and irradiating light through said holddown member at said adhesives It is made to make it possible to be able to carry out photo-curing of said adhesives, to be characterized by performing said immobilization, and to be able to use light for promotion of hardening, and to give a degree of freedom to the direction of radiation.
[0012] Invention of claim 3 prepares the through tube which is carrying out opening in invention of claims 1 or 2 to the gap prepared between said holddown members and said said positioned liquid crystal panels in said holddown member. Said adhesives are fed into said gap through said through tube, it is characterized by performing said immobilization, and there is no liquid lappet at the time of feeding, it is an approach with sufficient productive efficiency, and the feeding approach of the adhesives which can

respond to automation is acquired.
[0013] In invention of claim 3, the path of said through tube is characterized by being 1.5mmphi, and does not have ****** at the time of feeding, invention of claim 4 is an approach with sufficient productive efficiency, and the feeding approach of the adhesives which can respond to automation is acquired.
[0014] In invention of claims 3 or 4, by fixing to said holddown member the tubed part material which has flexibility, as the side edge by the side of the gap of said through tube is surrounded, invention of claim 5 is faced feeding said adhesives, and is characterized by stopping the unnecessary breadth of said adhesives.
[0015] Invention of claim 6 is faced manufacturing liquid crystal image projection equipment equipped with a liquid crystal panel. In the equipment for immobilization of the liquid crystal panel which uses this liquid crystal panel positioned in the location which can acquire the constitutionally optimal projection image of this liquid crystal image projection equipment for the process fixed to the holddown member which this liquid crystal image projection equipment has To the right reverse which prepared in said holddown member, is a ****** through tube and was established near the side edge of the through tube which carries out opening to the gap of said liquid crystal panel and said holddown member, the body of revolution in which a roll control is possible, It comes to contain with optical exposure tubing for performing said optical exposure to the nozzle for feeding said adhesives which protruded towards the exterior of this body of revolution as made the predetermined include angle mutually, and said photo-curing mold arrival agent. It is characterized by enabling it to perform continuously said feeding and said optical exposure of said adhesives with rotation actuation of said body of revolution. A series of processes from the adhesives restoration after positioning by the robot arm to immobilization by hardening can be automated by the way, time amount compaction of a process is made, and it is made for productivity to increase.
[0016] In invention of claim 6, from said feeding of said adhesives, when said body of revolution rotates only said predetermined include angle on the occasion of said optical exposure shifting, actuation invention of claim 7 By preparing on said body of revolution so that it may always become an orientation, without depending on said rotation actuation for the nozzle holder in which said nozzle which moved was held On the occasion of said optical exposure, it is characterize by prevent ****** at said tip of a nozzle, all a series of processes from the adhesives restoration after positioning by the robot arm to immobilization by hardening can be automate, time amount compaction of a process is make, and it is make for productivity to increase.
[0017]
[Embodiment of the Invention] This invention proposes the fixed approach of the liquid crystal panel by the adhesives shown in the following operation gestalten. Photo-curing mold adhesives are especially effective here. Photo-curing mold adhesives can perform time amount from positioning to immobilization within dozens of seconds. in addition -- and the following properties, i.e., viscosity, : 12000 - 20000CPS hardening degree of hardness : Shore-scleroscope-hardness D — or more 50 hardening contraction: -- 5% or less coefficient-of-thermal-expansion: — the degree of 10x10-5/ By using the adhesives which agreed below, distortion by the self-weight of a liquid crystal panel, distortion by deformation and hardening contraction, generating of unnecessary stress, etc. can be suppressed, and the fixed precision of a liquid crystal panel can be raised.
[0018] Like the above-mentioned, positioning of a liquid crystal panel is performed using the highly precise robot arm which can work to x, y, z and theta, thetah, and thetav, as shown in drawing 5 . The gap more than the adjustable range by said robot arm is between the light transmission nature stationary plate currently **** fixed to the optical unit, and the liquid crystal panel currently fixed to this stationary plate. Although that gap is filled up with adhesives and a liquid crystal panel is fixed, the through tube of **** 1.5mmphi is prepared, and in order to stop the liquid breadth of adhesives, the cylinder formed with the material which has the flexibility of rubber centering on a through tube etc. is

prepared in said gap at the stationary plate of the part filled up with these adhesives.
[0019] It fills up with photoresist adhesives in said cylinder from this through tube after positioning termination of a liquid crystal panel, and by performing an optical exposure through that glory permeability stationary plate, photo-curing is performed and it becomes fixed termination.
[0020] It is made to perform adhesive setting by adhesives restoration -> UV irradiation by continuous action by setting spacing of 45 degrees as an approach of attaining automation of this activity, on the periphery of the rotating drum prepared near said through tube, respectively, allotting UV irradiation tubing, an adhesives injection nozzle, and this nozzle holder in order, rotating this rotating drum, and controlling simple.
[0021] In order to perform all positioning of a liquid crystal panel with a robot arm, it stops needing members, such as a precision special to an optical unit, and a simple operation stage, according to this invention. Moreover, it becomes possible to automate altogether from positioning to immobilization, and time amount is also shortened sharply. Moreover, the location gap produced from positioning before immobilization by adhesive setting is suppressed by about several microns.
[0022] The operation gestalt of this invention is explained with reference to the attached drawing below at a detail. In addition, in the complete diagram for explaining an operation gestalt, the same sign is attached to the part which carries out the same operation, and explanation of the repeat is omitted. Drawing 1 is an important section enlarged drawing for explaining 1 operation gestalt of the hardening automation system which enforces the fixed approach of the liquid crystal panel by this invention. In one, a liquid crystal panel and 2 among drawing an optical unit and 4 for a robot arm and 3 A stationary plate, 5 — a through tube and 6 — for the tip of a flexible arm, and 9, as for a nozzle (needle) electrode holder and 11, an adhesives restoration nozzle and 10 are [eye an adhesives liquid pool and 7 / the tip (needle) of an adhesives restoration nozzle, and 8 / adhesives restoration / hardening arm and 16] rotating drums. Drawing 2 is the stationary plate and the enlarged drawing of eye an adhesives liquid pool which are shown in drawing 1 . Drawing 3 is the enlarged drawing of the rotating drum shown in drawing 1 .
[0023] As shown in drawing 1 , the liquid crystal panel 1 is held at the robot arm 2. This robot arm 2 can control the liquid crystal panel shown to drawing 5 that the Prior art explained in the six directions of the operation direction x, y, z and theta, thetah, and thetav. A through hole 5 is formed in the stationary plate 4 of the light transmission ingredient which returned to drawing 1 and was attached in the optical unit 3, and it is prepared in the fixed side of a liquid crystal panel 1 so that eye 6 an adhesives liquid pool of an elastomeric material may surround the perimeter of a through tube 5 focusing on this through tube 5. This partial enlarged drawing is shown in drawing 2 . Since the clearance between a liquid crystal panel and a stationary plate is changed about several mm, he is trying for thickness to have a curved-surface configuration by about 0.5mm as for eye this adhesives liquid pool, by positioning actuation of a liquid crystal panel, so that the variation rate of several mm at this time may be possible.
[0024] A rotating drum 16 is formed possible [a roll control], the tip (needle) 7 of the adhesives restoration nozzle 9 attached in this rotating drum 16 is inserted in a through tube 5, and adhesives restoration / hardening arm 11 is filled up with adhesives to the interior 6 an adhesives liquid pool. The through tube with which the tip 8 of the flexible arm which 45 degrees of circular drums 16 rotated after adhesives restoration, and was emitted from the optical irradiation equipment which is not illustrated. was filled up into adhesives is made to face, exposure light penetrates the stationary plate 4 of a light transmission ingredient, adhesives are reached, and photo-curing of adhesives is performed. Under the present circumstances, said adhesives restoration needle 7 was stored in the interior of the nozzle (needle) electrode holder 10 by rotation of a rotating drum 17, and the tip of a needle 7 has prevented getting it blocked by hardening of the adhesives by optical exposure. It is drawing 3 which carried out expansion illustration of this rotating-drum part.
[0025] As a result of actually inquiring in carrying out positioning immobilization of a liquid crystal panel by the above-mentioned approach, the property of adhesives and the dimension of a through tube were

optimized as follows.

1. As shown in drawing 1 , when the restoration part of adhesives was used as four angles of a liquid crystal panel and it is filled up with adhesives from the lower part of a liquid crystal panel, it is possible that adhesives ****** from a through tube 5 before hardening. Then, viscosity of 1.5mm and adhesives was set to 12000 – 20000CPS for the diameter of a through tube 5 as a specification from which there is no ****** and sufficient restoration rate is obtained.

2. If the degree of hardness after hardening of adhesives is low, location gap will arise with the load and stress to an optical unit. The degree of hardness at the time of hardening by the class of adhesives and hardening contraction, and the amount of the maximum gaps of the liquid crystal panel at this time are shown in Table 1. Consequently, when the hardening degree of hardness was low, it became clear also with the value with the same hardening contraction that the amount of location gap is large and 50 or more are desirable at Shore-scleroscope-hardness D.

[0026]

[Table 1]

接着剤の硬度、硬化収縮率と固定位置ズレデータ

硬度(シェアD)	硬化収縮(%)	最大ズレ(μm)
50	5.2	8.3
80	8.0	12.5
80	8.5	4.3
80	7.0	16.6
80	4.98	4.3
18	5.0	20.8
55	5.0	12.5
30	6.8	12.5
90	3.0	硬化せず

[0027] That by which the location gap by hardening contraction of adhesives is suppressed in 5 microns has the thing of less than 5% of hardening contraction more desirable than Table 1 like 3.2. As for this, it also becomes a requirement that the degree of hardness after hardening of 2 is 50 or more. Moreover, when current hardening contraction was made 2 to 3%, adhesives of 3% of hardening contraction shown in Table 1 as there are various problems were not hardened.

4. The coefficient of thermal expansion was made below into the degree of 10x10-5/from prevention of an optical unit, the stress by the temperature change with a stationary plate, or location gap.

[0028]

[Effect of the Invention] Effectiveness of claim 1: By limiting the material property of adhesives, distortion resulting from the self-weight of a liquid crystal panel or hardening contraction of adhesives, deformation, generating of unnecessary stress, etc. can be suppressed, and fixed precision can be raised. Effectiveness of claim 2: In addition to claim 1 effectiveness, it becomes possible using the adhesives of a photoresist to be able to use light for promotion of hardening, and to give a degree of freedom to the direction of radiation by making a holddown member into light transmission nature. Effectiveness of claims 3 and 4: In addition to the effectiveness of claims 1 or 2, by feeding adhesives through a through tube, there is no ****** at the time of feeding, it is an approach with sufficient productive efficiency, and the feeding approach of the adhesives which can respond to automation is acquired. Effectiveness of claim 5: On the occasion of feeding of adhesives, it becomes possible to stop the unnecessary breadth of adhesives by preparing the tubed part material which has the flexibility of rubber etc. in the perimeter of the liquid crystal panel side edge of a through tube in addition to the effectiveness of claims 3 and 4. Effectiveness of claims 6 and 7: All a series of processes from the adhesives restoration after positioning by the robot arm to immobilization by hardening can be automated, time amount compaction of a process is made, and productivity increases.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is an important section enlarged drawing for explaining 1 operation gestalt of the hardening automation system which enforces the fixed approach of the liquid crystal panel by this invention.
[Drawing 2] It is the stationary plate and the enlarged drawing of eye an adhesives liquid pool which are shown in drawing 1 .
[Drawing 3] It is the enlarged drawing of the rotating drum shown in drawing 1 .
[Drawing 4] It is the block diagram showing notionally the liquid crystal image projection equipment with which the fixed approach of a basing-on this invention liquid crystal panel is applied.
[Drawing 5] It is the perspective view of the liquid crystal panel in which the control axis for positioning of a liquid crystal panel is shown.
[Description of Notations]
1 [— A stationary plate, 5 / — A through tube, 6 / — Eye an adhesives liquid pool, 7 / — The tip (needle) of an adhesives restoration nozzle, 8 / — The tip of a flexible arm 9 / — An adhesives restoration nozzle, 10 / — A nozzle (needle) electrode holder, 11 / — Adhesives restoration / hardening arm 16 / — Rotating drum.] — A liquid crystal panel, 2 — A robot arm, 3 — An optical unit, 4

[Translation done.]